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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

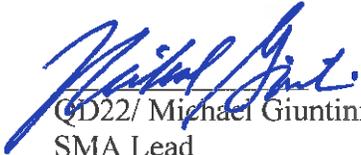
FP20

PLANETARY MISSIONS PROGRAM OFFICE SAFETY AND MISSION ASSURANCE GUIDELINES AND REQUIREMENTS

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FP20		
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1.0 Purpose

This document establishes the Safety and Mission Assurance (SMA) guidelines and requirements for the Discovery, New Frontiers, and Solar System Exploration Programs managed by the Planetary Missions Program Office (PMPO) as a means to ensure the mission success and safety of personnel, payloads, equipment, and facilities. It provides SMA requirements and guidance for non-NASA entities (research institutes, universities, contractors, etc.). NASA field offices and JPL have been approved to use their own SMA processes. A list of documents is included to be used as an SMA resource. It should be noted that some of these documents are requirements documents invoked by the top level requirements specified in this document.

2.0 Scope

These guidelines and requirements apply to the design, development, manufacturing, test, integration, flight operations, and pre- and post-mission ground operations phases of all projects within the Discovery, New Frontiers, and Solar System Exploration Programs. All statements in this document that use the verb “shall” are considered as requirements. Audits may be conducted at any time to verify compliance with these requirements.

In addition, tailoring processes are defined in NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority (TA). If any SMA requirement cannot be met, a deviation or waiver shall be submitted to the PMPO. A sample waiver form is included in this document as an attachment.

Further information on the scope of the SMA program is based on the payload classification as defined in NPR 8705.4, Risk Classification for NASA Payloads. The level of surveillance is dependent on payload classification and risk posture.

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3.0 Documents

3.1 Applicable Documents

ANSI Z540.3-2006, Requirements for Calibration Laboratories and Measuring and Test Equipment

NASA-STD-6016, Standard Materials and Processes Requirements for Spacecraft

NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority

NASA-STD-8729.1, Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program

NASA/TP-2003-212242, EEE-INST-002: Instructions for EEE Parts Selection, Screening, Qualification and Derating

NPR 7150.2, NASA Software Engineering Requirements

NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Record Keeping

NPR 8715.3, NASA General Safety Program Requirements

NPR 8715.7, Expendable Launch Vehicle (ELV) Payload Safety Program

NPR 8735.1 Procedures for Exchanging Parts, Materials, Software, and Safety Problem Data Utilizing the GIDEP and NASA Advisories

SAE-AS9100, Quality Management Systems: Requirement for Aviation, Space and Defense Organizations

3.2 Reference Documents

NPR 7120.5, NASA Space Flight Program and Project Management Requirements

NPR 8705.4, Risk Classification for NASA Payloads

NPD 8730.1, Metrology and Calibration

PMP-PLAN-001, Planetary Missions Program Plan

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4.0 Planetary Missions Program Office Overview

Program authority for planetary missions within the Discovery, New Frontiers, and Solar System Exploration Programs is delegated from the Science Mission Directorate (SMD) Associate Administrator, through the Planetary Science Division (PSD) Director, to the PSD Program Director, all at NASA Headquarters, to the Program Manager within the Planetary Missions Program Office (PMPO) at MSFC. The Program Manager performs the responsibilities contained in NPR 7120.5, NASA Space Flight Program and Project Management Requirements. The Program Manager at MSFC serves as the single point of contact for each program. MSFC staffs and manages the PMPO as shown in Figure 1 Planetary Missions Program Office Organization.

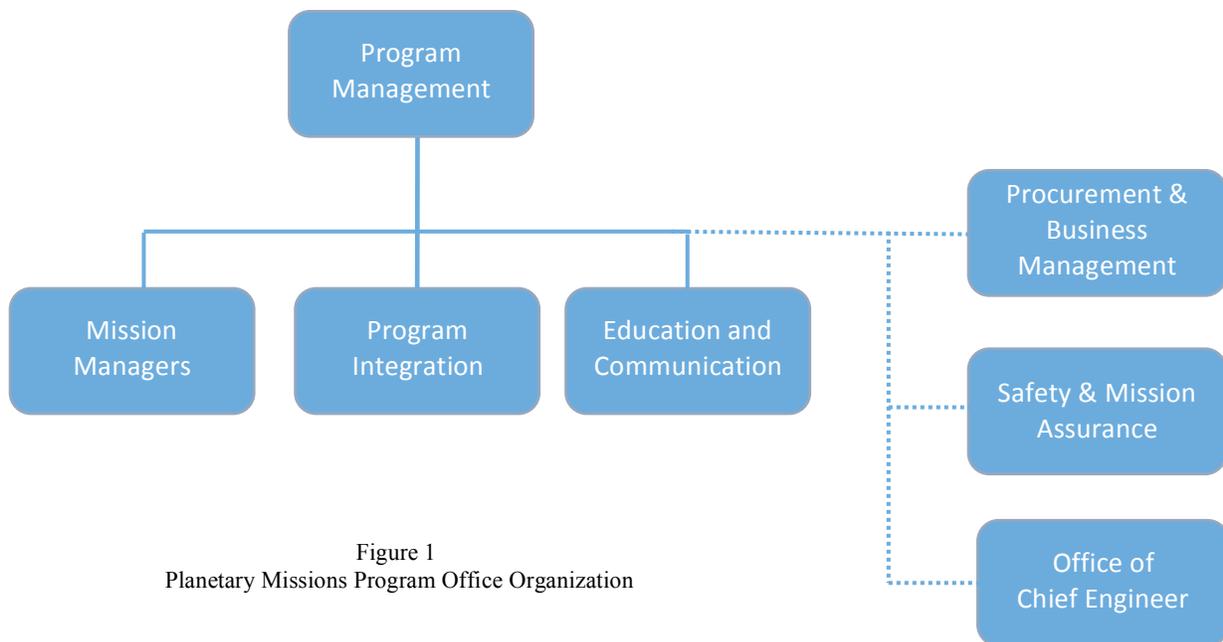


Figure 1
Planetary Missions Program Office Organization

The program management of missions within the Discovery, New Frontiers, and Solar System Exploration Programs is consolidated into a single management structure within the PMPO. The Planetary Missions Program Plan and all supporting program control plans integrate activities authorized by multiple Program Commitment Agreements (PCAs) into a common management system.

The programs are comprised of a series of space science missions that are independent and uncoupled, but share a common management structure. The missions are selected through a competitive process such as an Announcement of Opportunity (AO), or assigned directly to a center by the SMD. The programs include the following three types of projects:

AO-Selected Missions – These Principal Investigator (PI)-led missions are complete, self-standing, and uncoupled SMD investigations competed through an AO.

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Directed Missions – These missions are complete, stand-alone, uncoupled SMD investigations that are assigned directly to a center or implementing organization by the SMD. Projects assigned directly to a center are typically led by a project manager.

Missions of Opportunity (MO) – Historically PI-led, these projects are an element (instrument or other hardware contribution) of another mission. MOs are conducted on a no-exchange-of-funds basis with the organization sponsoring the full mission. NASA typically solicits proposals for MOs through the Stand Alone Mission of Opportunity Notice AO process.

Program level requirements for each project are approved by the SMD at the time of project confirmation, prior to the start of project implementation and are documented in a Program Level Requirements Appendix (PLRA) to PMP-PLAN-001, Planetary Missions Program Plan.

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5.0 Safety & Mission Assurance

5.1 System Safety

Projects should have a safety program that meets the intent of NPR 8715.3, NASA General Safety Program requirements and the safety program shall comply with NPR-8715.7, Expendable Launch Vehicle (ELV) Payload Safety Program. If the mission is to be flown on a manned vehicle, the manned vehicle requirements will be invoked on the payload. The safety program is intended to identify and eliminate/mitigate hazards to life and property. The project shall have an industrial safety program that complies with all of the applicable Occupational Safety and Health Administration (OSHA) regulations.

5.1.1 Mishap Planning

Projects shall develop a Mishap Contingency Plan that complies with NPR-8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Record Keeping. The Mishap Contingency Plan defines the process of documentation and notification of close calls and mishaps. To assure data is available for critical anomaly investigations to prevent future recurrence, telemetry coverage shall be provided during all mission critical events.

5.2 Reliability & Maintainability

A project shall have a reliability program. This reliability program shall comply with NASA-STD-8729.1, Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program. The reliability program must assess the mechanical, electrical, software and overall integrated design in order to identify areas to be improved to ensure mission success. Several methods can be used for this assessment including Failure Modes and Effects Analyses (FMEA), Probabilistic Risk Assessments (PRA), Fault Tree Analyses (FTA) and Worst Case Analyses (WCA). The scope of each analysis method is further defined in NPR 8705.4, Risk Classification for NASA Payloads. Project maintainability requirements are delineated in NPR 8705.4, Appendix C, Recommended SMA-Related Program Requirements for NASA Class A-D Payloads.

5.2.1 Critical Single Failure Points

Single failure points that could affect safety or impact primary mission objectives are not permitted on Class A payloads without a waiver.

5.2.2 Limited Life Items

Limited life items are defined as those items that have a limited useful life due to deterioration associated with the passage of time, mate and de-mate cycles, and operating time cycles. The project shall develop a plan to identify and control limited life items.

5.2.3 GIDEP

Projects shall be a member of the Government-Industry Data Exchange Program (GIDEP). The project shall comply with NPR 8735.1, Procedures for Exchanging Parts, Materials, Software,

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and Safety Problem Data Utilizing the GIDEP and NASA Advisories. The GIDEP provides a database of product failures from the aerospace and technical community that shall be assessed prior to purchasing or utilizing parts.

5.3 Quality Assurance

A project shall have a quality program complying with SAE-AS9100, Quality Management Systems: Requirement for Aviation, Space and Defense Organizations. All contractors and suppliers shall hold an AS9100 certification. Projects must have a closed loop nonconformance system that identifies the root cause, provides disposition and corrective action and ensures the corrective action has been implemented. The project shall establish a Material Review Board to determine proper disposition for nonconformances.

Additional requirements are levied for the following areas:

5.3.1 Electrical, Electronic and Electromechanical (EEE) Parts

Projects shall develop an EEE Parts Program that complies with the latest revision of NASA/TP-2003-212242, EEE-INST-002: Instructions for EEE Parts Selection, Screening, Qualification and Derating. Parts selection tailoring may be allowed with the approval of the Engineering TA and the Chief Safety Officer (CSO).

5.3.2 Metrology and Calibration

The Calibration system shall comply with ANSI Z540.3-2006, Requirements for Calibration Laboratories and Measuring and Test Equipment, as called for by NPD 8730.1 Metrology and Calibration.

5.3.3 Material and Processes

Projects shall implement a Materials and Processes program that establishes contamination requirements and maintains control of contamination. Outgassing of materials shall be addressed per NASA-STD-6016, Standard Materials and Processes Requirements for Spacecraft, and should use NASA Reference publication 1124, Outgassing Data for Selecting Spacecraft Materials. In addition, the NASA Material and Processes Technical Information System (MAPTIS) database should be used in the selection of materials. <http://maptis.nasa.gov/>

5.4 Software Assurance

A project's software development program shall comply with NPR 7150.2, NASA Software Engineering Requirements. NASA Independent Verification and Validation (IV&V) of software may be required depending on the payload classification or complexity of the system based on the requirements from NPR 8705.4 for the payload classification.

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Acronym List

ALERT	Acute Launch Emergency Reliability Tip
ANSI	American National Standards Institute
AO	Announcement of Opportunity
COTS	Commercial Off-the-Shelf
CSO	Chief Safety Officer
EEE	Electrical, Electronic and Electromechanical
FMEA	Failure Mode and Effects Analysis
FTA	Fault Tree Analysis
GIDEP	Government Industry Data Exchange Program
HA	Hazard Analysis
IV&V	Independent Verification and Validation
MO	Mission of Opportunity
MRB	Material Review Board
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
OSHA	Occupational Safety and Health Administration
PCA	Program Commitment Agreements
PI	Principal Investigator
PLRA	Program Level Requirements Appendix
PMPO	Planetary Missions Program
PRA	Probabilistic Risk Assessment
PSD	Planetary Science Division
R&M	Reliability and Maintainability
SAE	Society of Automotive Engineers
SMA	Safety and Mission Assurance
SMD	Science Mission Directorate
SPF	Single Point Failure
TA	Technical Authority
WCA	Worst Case Analysis

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Safety and Mission Assurance Resource Document List

AEROSPACE REPORT NO. ATR- 2011(5389)-1	Recommended Supplier Surveillance Practices and Independent Verification for Reaction Wheel Procurements – Aerospace Corporation
HOWI 8700-GB035	Management of the Safety and Mission Success Review
IEEE 730	Standard for Software Quality Assurance Plans—IEEE Computer Society Document
IPC 2221	Generic Standard on Printed Board Design
IPC 6011	Generic Performance Specification for Printed Boards
IPC 6012	Qualification and Performance Specification for Rigid Printed Boards—Incorporating Amendment 1:2007
IPC J-STD-001ES	Space Applications Electronic Hardware Addendum to J-STD- 001E Requirements for Soldered Electrical and Electronic Assemblies
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
MSFC-STD-2594	MSFC Threaded Fastener Management and Control Practices
NASA-HDBK-8719.14	Handbook for Limiting Orbital Debris
NASA Pub 1124	Outgassing Data for Selected Spacecraft Materials
NASA/SP-2011-3421	Probabilistic Risk Assessment Procedures Guide for NASA Managers and Practitioners, August 2002, http://www.hq.nasa.gov/office/codeq/doctree/praguide.pdf
NASA-STD- 8719.13	Software Safety Standard
NASA-STD-8719.14	Process for Limiting Orbital Debris
NASA-STD-8719.24	NASA Expendable Launch Vehicle Payload Safety Requirements
NASA-STD-8739.1	Workmanship Standard for Polymeric Application on Electronic Assemblies
NASA-STD-8739.2	Workmanship Standard for Surface Mount Technology
NASA-STD-8739.3	Soldered Electrical Connections
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses and Wiring

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NASA-STD-8739.5	Fiber Optic Terminations, Cable Assemblies and Installation
NASA-STD-8739.6	Implementation Requirements for NASA Workmanship Standards
NASA-STD-8739.8	Software Assurance Standard
NPD 1280.1	NASA Management System Policy
NPD 8700.1	NASA Policy for Safety and Mission Success
NPD 8700.3	Safety and Mission Assurance (SMA) Policy for NASA Spacecraft, Instruments, and Launch Services
NPD 8720.1	NASA Reliability and Maintainability (R&M) Program Policy
NPD 8730.5	NASA Quality Assurance Program Policy
NPR 7123.1	NASA Systems Engineering Processes and Requirements
NPR 8705.5	Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects
NPR 8705.6	Safety and Mission Assurance Audits, reviews and Assessments
NPR 8715.6	NASA Procedural Requirements for Limiting Orbital Debris
NUREG 0492	Fault Tree Handbook

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Attachment: Sample Waiver Approval Form

1. INITIATOR'S NAME/ORG:		DEVIATION/WAIVER APPROVAL REQUEST (DAR)		2. PCN:	3. DATE:
4. DAR NUMBER:		5. REVISION:		6. DEVIATION <input type="checkbox"/> WAIVER <input type="checkbox"/>	7. CONTRACT NUMBER:
8. PART NUMBER/DOCUMENT NUMBER:		9. PART/DOCUMENT DESCRIPTION:			
10. DAR TITLE:					
11. REJECTION DOCUMENT NUMBER:		12. SERIAL NUMBER(S):	13. LOT NUMBER:		14. QUANTITY:
15. SUPPLIER OR SUBCONTRACTOR NAME AND ADDRESS:			16. CONFIGURATION ITEM EFFECTIVITY:		
17. SPECIFIED REQUIREMENTS:					
18. DESCRIPTION OF DEPARTURE FROM REQUIREMENTS:					
19. JUSTIFICATION FOR DAR:					
20. ENVIRONMENTAL IMPACT: <input type="checkbox"/> Yes <input type="checkbox"/> No (If "yes", explain below or on MSFC Form 847-1)					
21. CORRECTIVE ACTION TAKEN: <input type="checkbox"/> Yes <input type="checkbox"/> No (If "yes", explain below or on MSFC Form 847-1)					
22. ICD AFFECTED: <input type="checkbox"/> Yes <input type="checkbox"/> No (If "yes", explain below or on MSFC Form 847-1)					
23. FMEA/CIL AFFECTED: <input type="checkbox"/> Yes <input type="checkbox"/> No (If "yes", explain below or on MSFC Form 847-1)					
24. CONTRACT COST IMPACTS: COST ADJUSTMENTS: <input type="checkbox"/> Yes <input type="checkbox"/> No (Explain below or on MSFC Form 847-1) – Explanation required whether yes or no.					
25. CONTRACTOR CERTIFICATION: THE CONTRACTOR HEREBY CERTIFIES THAT THE ABOVE DESCRIBED DAR IS A DEPARTURE FROM THE CONTRACTUAL REQUIREMENTS IN THE QUANTITIES AND/OR CONDITIONS AS STATED ABOVE. <div style="display: flex; justify-content: space-between;"> _____ _____ </div> <div style="display: flex; justify-content: space-between;"> SIGNATURE OR APPROVING AUTHORITY OF AUTHORIZED REPRESENTATIVE DATE </div>					
26. RESIDENT GOVERNMENT QUALITY REPRESENTATIVE: <input type="checkbox"/> CONCURRENCE <input type="checkbox"/> NONCONCURRENCE COMMENTS: (Explain below or on MSFC form 847-1): <div style="display: flex; justify-content: space-between;"> _____ _____ </div> <div style="display: flex; justify-content: space-between;"> SIGNATURE OR APPROVING AUTHORITY OF AUTHORIZED GOVERNMENT QUALITY REPRESENTATIVE DATE </div>					
27. MSFC CBD NUMBER: <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED <input type="checkbox"/> APPROVED SUBJECT TO CONDITIONS PER CCBD NUMBERED ABOVE		29. CONTRACTING OFFICER'S APPROVAL: <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED <input type="checkbox"/> APPROVED SUBJECT TO CONDITIONS STATED BELOW OR ON MSFC FORM 847-2 IMPLEMENTATION OF THIS DAR: <input type="checkbox"/> SHALL PROCEED <input type="checkbox"/> SHALL NOT PROCEED			
28. Contracting Officer's Technical Representative (COTR): <div style="display: flex; justify-content: space-between;"> _____ _____ </div> <div style="display: flex; justify-content: space-between;"> SIGNATURE OR CONCURRING OFFICIAL DATE </div>		<div style="display: flex; justify-content: space-between;"> _____ _____ </div> <div style="display: flex; justify-content: space-between;"> SIGNATURE OR APPROVING AUTHORITY DATE </div>		<div style="display: flex; justify-content: space-between;"> _____ _____ </div> <div style="display: flex; justify-content: space-between;"> CONTRACTOR NAME </div>	

MSFC Form 847 (Rev. April 2005)

_____ OF _____

PREVIOUS EDITIONS OBSOLETE

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DEVIATION/WAIVER APPROVAL REQUEST (DAR) MSFC FORM 847, PREPARATION INSTRUCTIONS

NOTE: In some electronic systems producing the DAR form (MSFC Form 847), the blocks are completed without the use of continuation or subject to conditions pages (MSFC Forms 847-1 and 847-2).

The following instructions refer to the numbered blocks on the DAR, MSFC Form 847. If additional space is required, MSFC Form 847-1 will be used to continue any block number. Reference the number of the block continued.

BLOCK 1 - INITIATOR'S NAME AND ORGANIZATION. For MSFC in-house generated DARs, enter the initiator's name and organizational mail code. For contractor or other Government organizations, enter the initiator's name and the name, address, and phone number of the organization/contractor submitting the DAR.

BLOCK 2 - PROGRAM CONTROL NUMBER (PCN). The configuration control board secretariat will assign and enter the PCN.

BLOCK 3 - DATE. Enter date the form is prepared.

BLOCK 4 - DAR NUMBER. For MSFC in-house generated DARs, enter the DAR number as assigned by the Release Desk. In some electronic systems, the DAR number will be printed at the top of each page for reference. The numbering systems established by contractor or other Government organizations will be used for contractor or other Government organization DARs.

BLOCK 5 - REVISION. Leave blank for an original DAR issuance. DAR revisions shall be identified by A, B, C, D, etc. All revisions to a DAR subsequent to submittal for processing require a revision to the submitted version. When a revision entry is made in this block, the following statement must be entered in Block 18: "This revision supersedes DAR No. _____ [include revision if applicable] in its entirety."

BLOCK 6 - DEVIATION OR WAIVER. Check one box based on the definitions of a deviation and a waiver.

BLOCK 7 - CONTRACT NUMBER. For in-house projects, leave blank. For contract-related DARs, enter the contract or purchase order number.

BLOCK 8 - PART NUMBER/DOCUMENT NUMBER. Enter part number, assembly number, or document number.

BLOCK 9 - PART/DOCUMENT DESCRIPTION. Enter description of the document, affected part, or configuration item identified by the entry in Block 8.

BLOCK 10 - DAR TITLE. Enter a title that is descriptive of the nonconformance.

BLOCK 11 - REJECTION DOCUMENT NUMBER. Enter the identification of the instrument recording the nonconformance that caused a rejection of the product (hardware, software, or firmware).

BLOCK 12 - SERIAL NUMBER(S). Enter the serial number(s) of the item(s), if applicable.

BLOCK 13 - LOT NUMBER. Enter the lot number of the item(s), if applicable.

BLOCK 14 - QUANTITY. Enter the quantity of items affected by the DAR.

BLOCK 15 - SUPPLIER OR SUBCONTRACTOR NAME AND ADDRESS. Enter the item supplier or subcontractor, if applicable.

BLOCK 16 - CONFIGURATION ITEM EFFECTIVITY. Enter the serial number(s) of the configuration item(s) that will contain or utilize the product(s) authorized by the approved DAR.

BLOCK 17 - SPECIFIED REQUIREMENTS. State the drawings, specifications, or other baseline data requirements being deviated from or waived.

BLOCK 18 - DESCRIPTION OF DEPARTURE FROM REQUIREMENTS. Describe the requested departure from the specified requirements. Describe the nonconformance as completely as possible showing the extent of the departure. Attach or, in some electronic systems, specify locations of sketches if required for clarification. The actual difference between the specified requirements and the variation shall be readily discernible.

BLOCK 19 - JUSTIFICATION FOR DAR. Enter the supporting rationale for the DAR. Include the safety impact statement that identifies the hazard documentation affected, reflects any associated risks, and indicates if baseline hazard/critical item list (CIL) documentation update is necessary.

BLOCK 20 - ENVIRONMENTAL IMPACT. Check either the "Yes" or "No" block indicating whether acceptance or disapproval of the deviation or waiver will result in an environmental impact. If "Yes," provide details.

BLOCK 21 - CORRECTIVE ACTION TAKEN. Check either the "Yes" or "No" block indicating whether corrective action has been taken. If "Yes," describe the action taken to resolve the need for the waiver or deviation in future applications.

BLOCK 22 - ICD AFFECTED. Check either the "Yes" or "No" block as to whether an ICD is affected by this DAR. If "Yes," define the details of the impact on the product's interfaces.

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DEVIATION/WAIVER APPROVAL REQUEST (DAR) MSFC FORM 847, PREPARATION INSTRUCTIONS (CONCLUDED)
<p>BLOCK 23 - FMEA/CIL AFFECTED. Check either the "Yes" or "No" block as to whether the Failure Mode and Effects Analysis (FMEA)/Critical Items List (CIL) is affected by this DAR. If "Yes," provide analysis as to how the FMEA/CIL is affected by this DAR.</p> <p>BLOCK 24 - CONTRACT COST IMPACTS. For MSFC-generated DARs, leave blank. For contractor-submitted DARs, check "Yes" or "No" as to whether there are cost impacts/cost adjustments. If "Yes," provide estimated cost benefits to the Government if the DAR is approved. If "No," provide justification why there is not a cost benefit to the Government.</p> <p>BLOCK 25 - CONTRACTOR CERTIFICATION. Authorized representative signs and dates this block or, in the controlled electronic system, electronic approval and date approved are indicated to certify that the information described in the DAR is a departure from contractual requirements in the quantities and/or conditions stated in the DAR.</p> <p>BLOCK 26 - RESIDENT GOVERNMENT QUALITY REPRESENTATIVE. For MSFC-generated DARs, this block shall be completed by the Quality representative assigned to the project. For contractor-generated DARs, the block shall be completed by the resident Quality Assurance Representative (QAR). Check "Concurrence" or "Nonconcurrence"; if "Nonconcurrence" is checked, enter comments. The block shall be signed and dated or, in the controlled electronic system, electronic approval and date approved are indicated.</p> <p>BLOCK 27 - MSFC CBD NUMBER. The CCB shall address cost adjustments. The configuration control board secretariat shall enter the control board directive (CBD) number and complete the block. In a non-electronic process, attach the CBD to this form.</p> <p>BLOCK 28 - CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (COTR). For contract-related DARs, the COTR shall sign and date to indicate concurrence. For in-house Programs/Projects, leave blank.</p> <p>BLOCK 29 - CONTRACTING OFFICER'S APPROVAL. For contract related DARs, this block shall be completed, signed, dated, and the contractor's name entered by the contracting officer or authorized representative; or, in the controlled electronic system, electronic approval and date approved are indicated. If "Approved Subject to Conditions" is checked, check either that "Implementation of this DAR shall proceed" or "Implementation of this DAR shall not proceed." For MSFC in-house Program/Project DARs, leave blank.</p> <p>PAGE NUMBER - The page number of the individual page and the total number of pages in the DAR shall be shown at the bottom center of each page (for example, 1 of 3, 2 of 3, 3 of 3, etc.).</p>